

CLAIMS

What is claimed is:

1. A process for a computer-implemented
5 hierarchical multidimensional scaling database for
images, the process comprising:

measuring dissimilarity of a set of images
using a feature detector;

10 obtaining a set of distances between control
points corresponding to images in a root node;

performing a single node update at the root
node to determine a first position in the root
node of an image being queried or added;

15 determining a first bounding box for a first
subnode, wherein the first subnode is a child of
the root node; and

20 determining a list of traversed nodes and
traversed control points, performing a single node
update at the first subnode, and sorting distances
to the traversed control points in the traversed
nodes, wherein the first subnode is a leaf node.

2. The process of Claim 1 further comprising:

25 obtaining a list of images in a second
subnode, wherein the second subnode is the child
of the first subnode; and

repeating the performing of the single node
update and the determining of a second bounding
box for the second subnode.

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3. A process for a computer-implemented
hierarchical multidimensional scaling database of
objects, the process comprising:

35 determining distances between control points
corresponding to objects in a root node of the

hierarchical multidimensional scaling database of objects; and

5 determining a position of a first control point in the root node for a first object, wherein the first object is being queried, and wherein the hierarchical multidimensional scaling database of objects comprises the root node and a first subnode, the first subnode being a child of the root node.

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4. The process of Claim 3 further comprising:
traversing a first subnode and performing a single node update on the first subnode;
performing the single node update at a leaf node, the leaf node being a descendant of the first subnode; and
determining traversed subnodes and traversed control points, and sorting distances between the traversed control points in the traversed subnodes and the control points in the root node to the first control point.

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5. The process of Claim 4 further comprising:
adding the first object to the hierarchical multidimensional scaling database, wherein the leaf node is subdivided if the leaf node is full, and wherein multidimensional scaling is executed on the leaf node and all bounding boxes in the traversed path to the first control point are updated.

6. The process of Claim 3 further comprising:
initializing the hierarchical multidimensional scaling database of objects by

executing instructions for approximating a convex hull.

7. The process of Claim 6 wherein the
5 hierarchical multidimensional scaling database of objects comprises a hierarchical multidimensional scaling representation of images, the images being stored in a memory of a data processing device.

10 8. A process for a computer-implemented hierarchical spatial database of objects, the process comprising:

15 calculating multiple stress vectors, wherein the multiple stress vectors represent stress factors between a first control point and multiple control points of the hierarchical spatial database, and wherein the multiple control points correspond to multiple objects, and the first control point corresponds to an object being queried; and

20 mapping the multiple stress vectors to multiple deformation vectors;

25 combining the multiple deformation vectors into a single node update vector; and

updating the first control point by moving a position of the first control point based on a fraction of the single node update vector.

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30 9. The process of Claim 8 wherein the multiple control points comprise multiple source control points, and the first control point comprises a target control point, wherein the calculating of the multiple stress vectors further comprises:

35 storing values for multiple source bundle fields and multiple target bundle fields; and

5 determining multiple source field values, the
multiple source field values corresponding to the
multiple source control points, the multiple
source control points being in a neighborhood of
the target control point,

10 wherein a position of the target control
point is modified using the source field values,
and wherein the stress on the target control point
in a node of the hierarchical spatial database is
minimized.

10. The process of Claim 9 wherein the fields
comprise local fields.

15 11. The process of Claim 9 wherein the fields
comprise anisotropic fields.

20 12. An article of manufacture for a hierarchical
multidimensional scaling database for objects, the
article of manufacture comprising:

25 a configuration for the hierarchical
multidimensional scaling database, the
hierarchical multidimensional scaling database
comprising a root node and a leaf node, the leaf
node being a subnode of the root node, wherein the
root node and the leaf node each comprise control
points corresponding to objects; and

30 a query manager, the query manager comprising
executable instructions for querying the
hierarchical multidimensional scaling database of
objects.

35 13. The article of manufacture of Claim 12
wherein the executable instructions of the query
manager further comprise:

instructions for obtaining a set of distances between control points corresponding to images in a root node; ,

5 instructions for performing a single node update at the root node to determine a position in the root node of an image being queried or added;

instructions for determining a bounding box for a first subnode, wherein the first subnode is a child of the root node; and

10 instructions for determining a list of traversed nodes and traversed control points, performing the single node update at the first subnode, and sorting distances to the traversed control points in the traversed nodes, wherein the 15 first subnode is a leaf node.

14. The article of manufacture of Claim 12, the executable instructions of the query manager further comprising:

20 instructions for calculating multiple stress vectors, wherein the multiple stress vectors represent stress between a first control point and multiple control points of a node of the hierarchical multidimensional scaling database, 25 and wherein the multiple control points correspond to multiple objects, and the first control point corresponds to an object being queried; and

instructions for mapping the multiple stress vectors to multiple deformation vectors;

30 instructions for combining the multiple deformation vectors into a single node update vector; and

instructions for modifying a position of the first control point by moving the position of the

first control point a fraction of the single node update vector.

15. The article of manufacture of Claim 12, the executable instructions of the query manager further comprising:

instructions for storing values for multiple source bundle fields and multiple target bundle fields; and

10 instructions for determining multiple source field values, the multiple source field values corresponding to multiple source control points, the multiple source control points being in a neighborhood of a target control point,

15 wherein a position of the target control point is modified using the source field values, and wherein the stress on the target control point in a node of the hierarchical multidimensional scaling database is minimized.

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16. The article of manufacture of Claim 15 wherein the instructions are implemented in a C++ programming language.

25 17. A machine executing instructions for a hierarchical multidimensional scaling database for objects, the machine comprising:

30 : instructions executed on a microprocessor of the machine for managing a configuration of the hierarchical multidimensional scaling database; and

35 instructions executed on the microprocessor of the machine for querying the hierarchical multidimensional scaling database, the objects being stored in a memory.

18. The machine of Claim 17 further comprising:
- 5 instructions executed on the microprocessor of the machine for obtaining a set of distances between control points corresponding to images in a root node;
- 10 instructions executed on the microprocessor of the machine for performing a single node update at the root node to determine a position in the root node of an image being queried or added;
- 15 instructions executed on the microprocessor of the machine for determining a bounding box for a first subnode, wherein the first subnode is a child of the root node; and
- 20 instructions executed on the microprocessor of the machine for determining a list of traversed nodes and traversed control points, performing a single node update at the first subnode, and sorting distances to the traversed control points in the traversed nodes, wherein the first subnode is a leaf node.
19. The machine of Claim 17 further comprising:
- 25 instructions executed on the microprocessor of the machine for calculating multiple stress vectors, wherein the multiple stress vectors represent stress between a first control point and multiple control points of a node of the hierarchical multidimensional scaling database, and wherein the control points correspond to multiple objects, and the first control point corresponds to an object being queried; and
- 30 instructions executed on the microprocessor of the machine for mapping the multiple stress vectors to multiple deformation vectors;

instructions executed on the microprocessor of the machine for combining the multiple deformation vectors into a single node update vector; and

5 instructions executed on the microprocessor of the machine for updating the first control point by moving the first control point a fraction of the single node update vector.

10 20. The machine of Claim 17 further comprising:
instructions executed on the microprocessor of the machine for storing values for multiple source bundle fields and multiple target bundle fields; and

15 instructions executed on the microprocessor of the machine for determining multiple source field values, the multiple source field values corresponding to multiple source control points, the multiple source control points being in a
20 neighborhood of a target control point,

wherein a position of the target control point is modified using the source field values, and wherein the stress on the target control point in a node of the hierarchical multidimensional
25 scaling database is minimized.

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